

What is claimed is:

- 1    1.     A radio frequency (RF) amplifier comprising:  
2           a resonant circuit having a plurality of circuit elements, said plurality of circuit  
3    elements including a voltage variable capacitance, said resonant circuit having a  
4    resonant frequency that depends upon a present value of said voltage variable  
5    capacitance; and  
6           a voltage adjustment unit in communication with said voltage variable  
7    capacitance to vary a bias voltage on said voltage variable capacitance to modify a  
8    capacitance value thereof.
- 1    2.     The RF amplifier claimed in claim 1, wherein:  
2           said voltage variable capacitance is a diffusion capacitance associated with a  
3    first transistor within the RF amplifier.
- 1    3.     The RF amplifier claimed in claim 2, wherein said first transistor is part of a  
2    cascode core within said RF amplifier.
- 1    4.     The RF amplifier claimed in claim 2, comprising:  
2           an output terminal to deliver an amplified signal to other circuitry, said first  
3    transistor being connected to said output terminal.
- 1    5.     The RF amplifier claimed in claim 2, comprising:  
2           a second transistor connected between said first transistor and a ground node,  
3    said second transistor having an input terminal to receive an RF input signal to be  
4    amplified by said RF amplifier.
- 1    6.     The RF amplifier claimed in claim 2, wherein:  
2           said first transistor includes an input terminal to receive an RF input signal to  
3    be amplified by said RF amplifier.

1 7. The RF amplifier claimed in claim 2, wherein:  
2 said voltage adjustment unit includes a third transistor having an input terminal  
3 to receive a control signal, said third transistor to vary a voltage drop between a supply  
4 node and said first transistor in response to variations in said control signal.

1 8. The RF amplifier claimed in claim 1, wherein:  
2 said voltage adjustment unit is connected between said resonant circuit and a  
3 supply node.

1 9. The RF amplifier claimed in claim 1, wherein:  
2 said voltage adjustment unit includes an input port to receive a control signal,  
3 said RF amplifier further including control circuitry coupled to said input port of said  
4 voltage adjustment unit to generate said control signal.

1 10. The RF amplifier claimed in claim 9, wherein:  
2 said control circuitry includes circuitry for tuning an operational frequency  
3 range of said RF amplifier using said control signal.

1 11. The RF amplifier claimed in claim 9, wherein:  
2 said control circuitry includes circuitry for automatically tuning an operational  
3 frequency range of said RF amplifier in the field to compensate for component aging.

1 12. The RF amplifier claimed in claim 1, wherein:  
2 said resonant circuit and said voltage adjustment unit are integrated on a  
3 common semiconductor chip.

1 13. The RF amplifier claimed in claim 12, further comprising:  
2 an integrated circuit package housing said common semiconductor chip, said  
3 integrated circuit package having a first pin connected to a supply node on said chip to

4 connect said RF amplifier to an external power supply, a second pin connected to a  
5 ground node on said chip to connect said RF amplifier to an external ground, and a  
6 third pin connected to an input terminal of said voltage adjustment unit to connect said  
7 RF amplifier to an external control signal source.

1 14. A method for tuning an integrated RF amplifier circuit comprising:  
2 providing an integrated RF amplifier including a resonant circuit having a  
3 plurality of circuit elements, said plurality of circuit elements including a voltage  
4 controllable parasitic capacitance;  
5 monitoring a resonant frequency of said integrated RF amplifier; and  
6 adjusting a bias voltage level on said voltage controllable parasitic capacitance  
7 until said resonant frequency is within a predetermined frequency range.

1 15. The method claimed in claim 14, wherein:  
2 said method is performed as part of a manufacturing test process.

1 16. The method claimed in claim 14, comprising:  
2 recording, after adjusting said bias voltage level, a parameter value related to  
3 a resulting bias voltage level.

1 17. The method claimed in claim 16, comprising:  
2 repeating adjusting and recording for another predetermined frequency range.

1 18. The method claimed in claim 17, comprising:  
2 generating a table of parameter values corresponding to a plurality of different  
3 operational frequency bands for subsequent use in tuning said integrated RF amplifier.

1 19. A radio frequency (RF) amplifier comprising:  
2 a first transistor having first and second output terminals, said first output  
3 terminal of said first transistor being coupled to an output node of said RF amplifier,

4 said first transistor having a parasitic capacitance that varies with a bias voltage applied  
5 to said first output terminal of said first transistor, said first transistor being held in  
6 saturation during operation of said RF amplifier;  
7 a resonant circuit coupled to said output node of said RF amplifier to provide  
8 a filter response on said output node, said parasitic capacitance of said first transistor  
9 affecting a center frequency of said filter response; and  
10 a tuning transistor having an input terminal and first and second output  
11 terminals, said input terminal of said tuning transistor to receive a control signal, said  
12 first output terminal of said tuning transistor being coupled to a supply node, and said  
13 second output terminal of said tuning transistor in communication with said first output  
14 terminal of said first transistor, said tuning transistor to vary a voltage drop between  
15 said supply node and said first output terminal of said first transistor in response to  
16 variations in said control signal during amplifier operation.

1 20. The RF amplifier claimed in claim 19, wherein:

2 said tuning transistor blocks power supply noise from said supply node during  
3 amplifier operation.

1 21. The RF amplifier claimed in claim 19, wherein:

2 said first transistor, said resonant circuit, and said tuning transistor are  
3 integrated on a common semiconductor chip.

1 22. The RF amplifier claimed in claim 19, wherein said RF amplifier is a single  
2 ended amplifier.

1 23. The RF amplifier claimed in claim 19, wherein said RF amplifier is a  
2 differential amplifier.

1 24. The RF amplifier claimed in claim 19, comprising:  
2 a controller to generate said control signal on said input terminal of said tuning  
3 transistor, said controller to generate said control signal in a manner that tunes an  
4 operational frequency range of said RF amplifier.

1 25. A multi-band radio frequency (RF) receiver system comprising:  
2 a multi-band low noise amplifier (LNA) to amplify a receive signal, said multi-  
3 band LNA including a resonant circuit having a plurality of circuit elements, said  
4 plurality of circuit elements including a voltage variable capacitance, said multi-band  
5 LNA having a plurality of operational frequency bands, wherein a present operational  
6 frequency band of said multi-band LNA depends upon a present value of said voltage  
7 variable capacitance;  
8 a receiver coupled to an output of said multi-band low noise amplifier to process  
9 an amplified version of said receive signal; and  
10 a controller coupled to said multi-band LNA to change a value of said voltage  
11 variable capacitance when a change in the operational frequency range of said multi-  
12 band LNA is desired.

1 26. The multi-band RF receiver system claimed in claim 25, wherein:  
2 said multi-band LNA includes a voltage adjustment unit to vary a bias voltage  
3 on said voltage variable capacitance based on a control signal generated by said  
4 controller.

1 27. The multi-band RF receiver system claimed in claim 26, wherein:  
2 said voltage adjustment unit includes a transistor having two output terminals  
3 that are coupled between a supply terminal and said voltage variable capacitance.

1 28. The multi-band RF receiver system claimed in claim 25, wherein:  
2 said multi-band LNA includes a cascode core having multiple transistors,  
3 wherein said voltage variable capacitance of said resonant circuit is a parasitic  
4 capacitance of one of said multiple transistors.

1 29. The multi-band RF receiver system claimed in claim 25, wherein:  
2 said multi-band LNA, said receiver, and said controller are integrated onto a  
3 common semiconductor chip.

1 30. The multi-band RF receiver system claimed in claim 25, comprising:  
2 a look up table (LUT) to store a plurality of control values that each correspond  
3 to a particular operational frequency band of said multi-band LNA.

1 31. An electronic system comprising:  
2 an antenna;  
3 a cascode core including an input transistor to receive a signal from the  
4 antenna and a first transistor having a parasitic capacitance that varies with a bias  
5 voltage applied thereto; and  
6 a tuning transistor to vary the bias voltage on the first transistor.

1 32. The electronic system of claim 31 further comprising a resonant circuit  
2 coupled between the tuning transistor and the cascode core, said parasitic  
3 capacitance of said first transistor affecting a center frequency of said resonant  
4 circuit.

1 33. The electronic system of claim 31 further comprising a controller to  
2 influence the bias voltage on the first transistor.

1 34. The electronic system of claim 33 further comprising a lookup table coupled  
2 to the controller, the lookup table to store values that influence the bias voltage on  
3 the first transistor.

1 35. An electronic system comprising:  
2 an amplifier including a cascode core having a transistor with a parasitic  
3 capacitance that varies with a bias voltage, and including a control transistor to vary  
4 the bias voltage;  
5 a receiver to receive a first signal from the amplifier; and  
6 a signal processing unit to receive a second signal from the receiver.

1 36. The electronic system of claim 35 further comprising a lookup table to  
2 influence operation of the control transistor.

1 37. The electronic system of claim 36 further comprising a controller coupled  
2 between the lookup table and the control transistor.

- 1 38. The multi-band RF receiver system claimed in claim 25, wherein:  
2 said multi-band LNA is a differential amplifier.
- 1 39. The multi-band RF receiver system claimed in claim 25, wherein:  
2 said resonant circuit further comprises an inductor and a capacitor coupled in  
3 parallel.
- 1 40. The multi-band RF receiver system claimed in claim 25, further comprising:  
2 a receive antenna coupled to said multi-band LNA to receive said receive signal  
3 from an exterior environment and to transfer said receive signal to said multi-band LNA;  
4 and  
5 a signal processing unit coupled to said receiver to receive a baseband signal to  
6 process said baseband signal.
- 1 41. The electronic system of claim 32, wherein:  
2 said resonant circuit further comprises an inductor and a capacitor coupled in  
3 parallel.
- 1 42. The electronic system of claim 33, wherein:  
2 said tuning transistor comprises two output terminals coupled between a supply  
3 terminal and said first transistor, said tuning transistor further comprising a control  
4 terminal coupled to said controller to receive a control signal.
- 1 43. The electronic system of claim 31, wherein:  
2 said cascode core, said tuning transistor, and a resonant circuit coupled between  
3 said cascode core and said tuning transistor comprise a low noise amplifier (LNA) to  
4 amplify said signal from said antenna to generate an amplified signal; and  
5 further comprising:  
6 a receiver coupled to the LNA to receive said amplified signal from said  
7 LNA and to generate a baseband signal from said amplified signal; and



8                   a signal processing unit coupled to said receiver to receive said baseband  
9 signal to process said baseband signal.

1   44.    The electronic system of claim 43, wherein:  
2           said LNA is a differential amplifier.

1   45.    The electronic system of claim 43, wherein:  
2           said LNA, said receiver, a controller coupled to the LNA, and a look up table  
3 (LUT) coupled to the controller are integrated on a common semiconductor chip.

1   46.    The electronic system of claim 37, wherein:  
2           said amplifier, said receiver, said controller, and said lookup table are integrated  
3 on a common semiconductor chip.

1   47.    The electronic system of claim 35, wherein:  
2           said amplifier further comprises a resonant circuit coupled between said cascode  
3 core and said control transistor, said resonant circuit comprising an inductor and a  
4 capacitor coupled in parallel.

1   48.    The electronic system of claim 47, wherein:  
2           said amplifier is a differential amplifier.

1   49.    The electronic system of claim 35, further comprising:  
2           a receive antenna coupled to said amplifier to receive an RF signal from an  
3 exterior environment and to transfer said RF signal to said amplifier.

1   50.    An electronic system comprising:  
2           a dipole antenna to receive an RF signal from an exterior environment;  
3           a low noise amplifier (LNA) coupled to said dipole antenna to receive said RF  
4 signal to amplify said RF signal with a resonant circuit to generate an amplified signal,

5 said resonant circuit comprising a parasitic capacitance that varies with a bias voltage on  
6 said parasitic capacitance to adjust a resonant frequency of said resonant circuit;  
7 a controller coupled to said LNA to vary said bias voltage on said parasitic  
8 capacitance;  
9 a look up table coupled to said controller to provide control values to said  
10 controller;  
11 a receiver coupled to said LNA to receive said amplified signal from said LNA  
12 and to generate a baseband signal from said amplified signal; and  
13 a signal processing unit coupled to said receiver to receive said baseband signal to  
14 process said baseband signal.

1 51. The electronic system of claim 50, wherein:  
2 said LNA is a differential amplifier.

1 52. The electronic system of claim 50, wherein:  
2 said resonant circuit comprises an inductor and a capacitor coupled in parallel  
3 between a cascode core and a control transistor, said cascode core comprising a transistor  
4 comprising said parasitic capacitance, said control transistor comprising a control  
5 terminal coupled to said controller to receive a control signal based on said control values  
6 from said look up table, said control transistor further comprising two terminals coupled  
7 between a supply terminal and said parasitic capacitance.

1 53. A method for operating an electronic system comprising:  
2 receiving an RF signal at an antenna;  
3 amplifying said RF signal in an amplifier coupled to said antenna with a resonant  
4 circuit in said amplifier to generate an amplified signal;  
5 adjusting a bias voltage on a parasitic capacitance in said resonant circuit with a  
6 controller coupled to said amplifier to vary said parasitic capacitance to change a  
7 resonant frequency of said resonant circuit;  
8 providing control values to said controller from a look up table coupled to said  
9 controller, said controller to adjust said bias voltage according to said control values;

10           generating a baseband signal from said amplified signal in a receiver coupled to  
11   said amplifier; and  
12           processing said baseband signal in a signal processing unit coupled to said  
13   receiver.

1   54.    The method of claim 53, wherein:  
2           amplifying said RF signal further comprises amplifying said RF signal in a  
3   differential amplifier coupled to said antenna with a resonant circuit in said differential  
4   amplifier to generate said amplified signal.

1   55.    The method of claim 53, wherein:  
2           adjusting a bias voltage further comprises adjusting said bias voltage on a  
3   transistor comprising said parasitic capacitance in a cascode core in said resonant circuit  
4   by controlling a control transistor with a control signal from said controller, said control  
5   transistor further comprising two terminals coupled between a supply terminal and said  
6   parasitic capacitance; and  
7           amplifying said RF signal further comprises filtering said RF signal to pass signal  
8   components within a desired operational frequency range with said resonant circuit, said  
9   resonant circuit comprising an inductor and a capacitor coupled in parallel between said  
10   cascode core and said control transistor to generate said amplified signal.

1   56.    The method of claim 53, wherein adjusting a bias voltage further comprises:  
2           monitoring said resonant frequency of said resonant circuit; and  
3           adjusting said bias voltage on a transistor comprising said parasitic capacitance in  
4   a cascode core in the resonant circuit by controlling a control transistor with a control  
5   signal from said controller until said resonant frequency is within a predetermined  
6   frequency range, said control transistor further comprising two terminals coupled  
7   between a supply terminal and said parasitic capacitance.

1   57.    The method of claim 56, further comprising:

2 blocking power supply noise from said supply terminal during operation of said  
3 amplifier with said control transistor.

1 58. The method of claim 53, wherein adjusting a bias voltage further comprises:  
2 providing a control value to said controller from said look up table to change a  
3 frequency range of the amplifier; and  
4 applying said control value to the amplifier to adjust said bias voltage to tune said  
5 amplifier to a desired frequency range.

1 59. The method of claim 58, further comprising:  
2 monitoring the amplified signal from the amplifier in the controller to confirm  
3 that the amplifier is tuned;  
4 modifying said control value applied to the amplifier from the controller to adjust  
5 said bias voltage to tune said amplifier; and  
6 storing said modified control value in the look up table.

1 60. The method of claim 53, wherein adjusting a bias voltage further comprises:  
2 providing a control value to said controller from said look up table to change a  
3 frequency range of said receiver; and  
4 applying said control value to said receiver to tune said receiver to a desired  
5 frequency range.

1 61. The method of claim 53, wherein adjusting a bias voltage further comprises  
2 varying a supply voltage applied to said amplifier from said controller to adjust said bias  
3 voltage on said parasitic capacitance.

1 62. The method of claim 53, wherein amplifying said RF signal further comprises  
2 amplifying said RF signal in a low noise amplifier (LNA) coupled to said antenna.

1 63. The method of claim 53, further comprising:

2            recording, after adjusting said bias voltage, a parameter value related to said bias  
3 voltage for an operational frequency range;  
4            repeating the adjusting and recording operations for a different operational  
5 frequency range; and  
6            generating a table of parameter values corresponding to a plurality of different  
7 operational frequency ranges for subsequent use in tuning said amplifier.